

DEPARTMENT OF ENERGY
FY 2002 CONGRESSIONAL BUDGET REQUEST

FOSSIL ENERGY RESEARCH AND DEVELOPMENT

FUELS

I. **Mission Supporting Goals and Objectives:**

Title XIII, Subtitle A, Sections 1305 and 1312 of the Energy Policy Act (EPACT) of 1992 authorizes separate programs for research, development, demonstration and commercial application of improved technologies to refine coal to a variety of fuel and non-fuel products and to convert coal into oil substitutes. In compliance with these provisions of EPACT and consistent with these goals, the Fuels Program consists of four related activities: Transportation Fuels and Chemicals, Solids Fuels and Feedstocks, Advanced Fuels Research, and Steelmaking.

Transportation Fuels and Chemicals - The need for liquid fuels is projected to be a critical element of this nation's energy future in the 21st century. The objective of the program is to develop environmentally superior processes in partnership with industry and other government organizations to help industry develop and provide the ultra-clean transportation fuels needed for the 21st century. These fuels will meet the proposed stringent EPA Tier II transportation vehicle standards to be implemented starting in 2004 and other more stringent environmental standards which could follow to reduce environmental pollution from the transportation sector. This is part of a comprehensive, unified Office of Fossil Energy (Office of Oil & Gas, Office of Coal & Power Systems) fuels program to provide options for ultra-clean fuels for the near-, intermediate-, and long-term to meet our Nation's transportation fuel needs and environmental imperatives. The gas conversion research efforts include research and development of ceramic membrane reactors to separate air and partial oxidation of gas to produce less costly synthesis gas, innovative processes to chemically convert gas to readily transportable, competitively priced liquid transportation fuels as well as blending agents able to improve the environmental acceptability of petroleum-based fuels. In the coal research area in the intermediate-term, these fuels will be products from coproduction facilities which will use multiple feedstocks to produce transportation fuels, chemicals and electricity, and in the longer term, these fuels will be produced from stand-alone plants which will integrate advanced sequestration technologies facilitating the closing of the carbon cycle.

I. Mission Supporting Goals and Objectives: FUELS (Cont'd)

The Department's efforts currently are focused on generation and production of synthesis gases (i.e. a mixture of carbon monoxide and hydrogen) and the subsequent catalytic conversion of the synthesis gas to liquid fuels and other products. The Transportation Fuels and Chemicals program is cosponsoring the development of Early Entry Coproduction Plant (EECP) technologies with the Integrated Gasification Combined Cycle (IGCC) program. These gasification-based plants would coproduce some combination of power, fuels and chemicals with high efficiency and reduced capital cost, thus facilitating early commercial entry of both IGCC power and coal-derived fuels and chemicals. Concurrent with the EECP effort, the development of ultra-clean fuels for the 21st century will be implemented through a partnership with the Natural Gas Processing and the Petroleum Processing programs. The Ultra-Clean Fuels Program is included as a separate budget line in the FY 2002 budget. The goal is to work with industry to develop technologies that will enable them to utilize more effectively, the global fossil resources to produce these fuels that can meet increasingly stringent vehicle emissions requirements. The activities sponsored by the Transportation Fuels and Chemicals program are also being coordinated with the Office of Transportation Technologies (EE). A current focus is on working the EE's Office of Heavy Vehicle Technology to develop premium fuels for advanced diesel engines for use in sports/utility vehicles, light trucks and to develop fuels suitable for use in the vehicles resulting from the Partnership for a New Generation of Vehicles (PNGV) program. These surface transportation systems will achieve significantly greater efficiency with substantially lower emissions.

Solid Fuels and Feedstocks - The program's funding is directed toward the development of advanced technologies to: (1) improve the overall efficiency, economics, and environmental performance of energy utilization systems, (2) reduce environmental impacts associated with the generation of greenhouse gases and hazardous air pollutants from utilization of coal, (3) permit greater carbon recovery efficiencies yielding more useful energy from the coal that is mined, (4) recover previously discarded carbon raw materials from waste culm piles and settling ponds, (5) support the evolution of significant new industry through the development of technology and processes for the production of premium carbon and industrial products, and (6) create a data base, through comprehensive testing and evaluation of coals of international economic importance, that is essential to the transfer and utilization of U.S. technology in international markets. The program will conduct international collaborative R&D activities with key foreign laboratories, universities and industry research entities on hydrogen, high volume oxygen separation and other key activities aimed at accelerating/broadening Vision 21 technologies and their use abroad. These technologies will significantly increase the efficiency with which energy from coal is produced, recovered and utilized, create new markets for innovative new products needed to satisfy a more sophisticated consumer demand, and improve the environment through the reduction and/or elimination of waste from energy utilization processes and eliminate past environmental insults.

I. **Mission Supporting Goals and Objectives:** FUELS (Cont'd)

by cleaning up the residues of previous activities, and finally reduce the emissions of some of the more toxic air-borne emissions by removing them before they enter the energy utilization process.

Advanced Fuels Research - The activities supported by this effort are responsive to the concept of “Grand Challenges” as being those technology barriers that either have the ability to limit the use of coal as a national energy resource on a sustainable basis or, if developed will insure the role of coal as a viable source of energy during the next century. The concepts that mark the work undertaken in this effort are considered to be “technology breakthroughs”. The research and development work includes examining the potential of these breakthrough concepts to produce transportation fuels, chemicals and carbon products at exceptionally high efficiencies, and with significant economic gains, and minimum environmental impact as well as to make major strides in efforts to close the carbon cycle.

Steelmaking - The overall goal of the Steelmaking Program is to accelerate the development of advanced processes for the environmentally acceptable production of iron. The activity supported by this effort is the development of a simple, low-cost method for production of iron from coal and ore concentrate through “direct reduction”. This revolutionary process is designed to use the lowest cost feedstocks and facilitate integration into existing facilities at any scale, due to its modular design. Successful development will provide iron at costs below any existing or planned process and help make up the expected 10 million ton per year shortfall in iron.

FY 2002 performance measures in furtherance of the above goals include:

- Continue the development of improved ceramic membranes for synthesis gas production from gas.
- Continue the development of advanced technologies to create new industries for the production of premium carbon and industrial products from coal.

II. A. **Funding Schedule:** FUELS (Cont'd)

<u>Activity</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>\$Change</u>	<u>%Change</u>
Transportation Fuels and Chemicals	\$6,928	\$7,558	\$5,000	\$-2,558	-34%
Solid Fuels and Feedstocks	4,232	4,291	2,000	-2,291	-53%
Advanced Fuels Research	2,160	4,889	0	-4,889	-100%
Steelmaking	<u>6,524</u>	<u>6,685</u>	<u>0</u>	<u>-6,685</u>	<u>-100%</u>
Total, Fuels	<u>\$19,844</u>	<u>\$23,423</u>	<u>\$7,000</u>	<u>\$-16,423</u>	<u>-70%</u>

II. B. **Laboratory and Facility Funding Schedule:**

	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>\$Change</u>	<u>%Change</u>
National Energy Technology Laboratory	\$3,683	\$3,555	\$2,000	\$-1,555	-44%
Argonne National Laboratory	35	0	0	0	0%
Sandia National Laboratories	350	600	0	-600	-100%
All Other	<u>15,776</u>	<u>19,268</u>	<u>5,000</u>	<u>-14,268</u>	<u>-74%</u>
Total, Fuels	<u>\$19,844</u>	<u>\$23,423</u>	<u>\$7,000</u>	<u>\$-16,423</u>	<u>-70%</u>

III. **Performance Summary:**

<u>Activity</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>
Transportation Fuels and Chemicals (Cont'd)	Feedstock Conversion: Study of novel concepts for achieving improved lower severity conversion and specification products. (\$35). Conduct LaPorte alternative fuels facility operation	Feedstock Conversion: Study of novel concepts for improved conversion efficiency and product quality. (\$800) (NETL)	Feedstock Conversion: Conclude all activity in an orderly manner with prior year funds. (\$0)

III. Performance Summary: FUELS (Cont'd)

Activity	FY 2000	FY 2001	FY 2002
Transportation Fuels and Chemicals (Cont'd)	<p>for production of Fischer-Tropsch diesel for engine testing in cooperation with the Office of Energy Efficiency and the Fossil Energy Office of Oil and Gas (\$395). (Total \$430) (ANL, APCI)</p> <p>Reactor/Process Development: Continue bench scale DME research; develop ultra-clean transportation fuels and chemicals for the 21st Century (\$1,480). Continue NETL in-house research on Fischer-Tropsch (F-T) chemistry. Continue bench scale F-T iron catalyst development for coproduction of electricity, fuels and chemicals (\$1,087). Conduct slurry F-T design data base; conduct feasibility studies, R&D and design for the Early Entrance Coproduction Plant with industrial consortium, and perform research on advanced hydrogen/synthesis gas production processes (\$2,499) (Total \$5,066) (Air Products, NETL, CAER, WMPI, Dynergy,</p>	<p>Reactor/Process Development: Continue bench scale DME at APCI; continue the development of ultra-clean transportation fuels and chemicals for the 21st Century (\$2,259). Continue bench scale F-T iron catalyst development for the production of premium transportation fuels and chemicals (\$260). International Clean Energy Initiative: Develop and test the feasibility of technical options for hydrogen to make high-value transportation fuels and other products for the international deployment of the technologies (\$500). Conduct slurry F-T reactor design data base; continue feasibility study, R&D, and design of the Early Entrance Coproduct-</p>	<p>Reactor/Process Development: Conclude all activity in an orderly manner with prior year funds. (\$0)</p>

III. **Performance Summary:** FUELS (Cont'd)

Activity	FY 2000	FY 2001	FY 2002
	Texaco, TBD)	ion Plant with industry consortium. (\$2,900). (Total \$5,919) (Air Products, NETL, CAER, WMPI, Dynergy, Texaco, TBD)	
Transportation Fuels and Chemicals (Cont'd)	Product Upgrading: Continue research on DME/diesel blends; characterize coal-derived transportation fuels. (\$682) (PSU, NETL)	Product Upgrading: Continue research on DME/diesel blends, characterize coal-derived transportation fuels. (\$260) (PSU, NETL)	Product Upgrading: Conclude all activity in an orderly manner with prior year funds. (\$0)
	Systems Engineering: Continue research guidance study and engineering support. NETL technical and engineering analyses. (\$679) (Mitretek, NETL, TBD)	Systems Engineering: Continue technical, economic and environmental analyses; engineering support and technical guidance. (\$503) (Mitretek, NETL, TBD)	Systems Engineering: Conclude all activity in an orderly manner with prior year funds. (\$0)
	No activity. (\$0)	No activity. (\$0)	Continue exploratory research activities of novel conversion concepts of promising chemical and small-scale physical conversion technology innovations. Continue research and develop- of a novel syngas ceramic membrane technology to enhance Fischer-Tropsch (F-T) gas conversion for

III. **Performance Summary:** FUELS (Cont'd)

<u>Activity</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>
			environmentally superior liquid fuels and hydrogen (\$3,950). Conduct fundamental supporting fuels research at NETL (\$1,000). (Total \$4,950) (APCI, NETL, TBD)
	Fund technical and program management support. (\$71)	Fund technical and program management support. (\$76)	Fund technical and program management support. (\$50)
	\$6,928	\$7,558	\$5,000
Solid Fuels and Feedstocks	Environmental Solid Fuels: Continue research on advanced technologies for the reduction of greenhouse gas emissions via the preparation of biomass feeds for cofiring applications and the development of composite coal/biomass/waste fuels; the pre-combustion removal of air toxic precursors at significantly lower cost than achievable with current technologies; and remediation of coal fines disposal problems via improved fine coal recovery, dewatering, and handling. (\$2,162)	Environmental Technologies: Continue support of the development of a national coal quality data base on trace elements (\$30). Tailored Fuels: Conduct research on technologies for enhanced carbon recovery from coal and coal waste products, improved coal fines processing, and the preparation of coal/biomass/waste for gasification and co-firing applications to lower emissions of greenhouse gases (\$2,491). (Total \$2,521) (NETL, TBD)	Environmental Technologies: Conclude all activity in an orderly manner with prior year funds. (\$0)

III. **Performance Summary:** FUELS (Cont'd)

Activity	FY 2000	FY 2001	FY 2002
	(NETL, TBD)		
Solid Fuels and Feedstocks (Cont'd)	Tailored Carbon Feedstocks: Continue research for advanced technologies for the development of premium carbon products from coal and the preparation of tailored feedstocks for the production of advanced transportation fuels and chemicals from coal/biomass/waste feeds. (\$2,027) (NETL, TBD)	Premium Carbon Products: Conduct technical/economic assessments and laboratory and bench scale research on technologies for the manufacture of carbon products. Conduct research at outside facilities for advanced technologies for the premium carbon products from coal via an industry-led and cost-shared consortium (\$1,427). Advanced Separations: Conduct research in the areas of advanced technologies for solid-solid and solid-liquid separations directed toward fuels production and use (\$300). (Total \$1,727) (NETL, Penn State, TBD)	Premium Carbon Products: Conduct technical/economic assessments and laboratory and bench scale research on technologies for the manufacture of carbon products. Conduct research at outside facilities for advanced technologies for the premium carbon products from coal via an industry-led and cost-shared consortium (\$1,980). Advanced Separations: Conclude research in the areas of advanced technologies for solid-solid and solid-liquid separation with prior year funds (\$0). (Total \$1,980) (NETL, Penn State, TBD)
	Fund technical and program management support. (\$43)	Fund technical and program management support. (\$43)	Fund technical and program management support. (\$20)
	\$4,232	\$4,291	\$2,000
Advanced Fuels Research	Conduct research to identify liquid fuels that are suitable as chemical storage agents for hydrogen and	C-1 Chemistry: Cosponsor investigation of the chemistry of monocarbon compounds for the	C-1 Chemistry: Conclude all activity in an orderly manner with prior year funds. (\$0)

III. Performance Summary: FUELS (Cont'd)

Activity	FY 2000	FY 2001	FY 2002
Advanced Fuels Research (Cont'd)	that may be easily reformed on board fuel cell powered vehicles. Conduct research on fuel and chemical production aspects of Vision 21 technologies, and continue exploratory research and laboratory activities for the production of high value products from coal. Conduct molecular modeling for simulating the growth of carbon structures, investigating molecular interactions, and designing catalysts. (\$1,278) (NETL, Univ. of KY, WVU, CFFLS, TBD)	production of hydrogen, syngas, strategic chemicals and transportation fuels with the EE Office of Advanced Automotive Technologies. Investigate advanced clean diesel and diesel additive production technologies and the production of high value chemicals within the Vision 21 concept (\$789). Hydrogen Economy Enabling Science: Conduct research on enabling science for the hydrogen economy including production of hydrogen from fossil resources and the study of novel media for physical and chemical hydrogen storage. (\$839). (Total \$1,628) (NETL, CFFLS, TBD)	
	Conduct research on new and improved methods for producing liquid transportation fuels and chemicals which will be highly efficient, achieve improved environmental performance with	Molecular Modeling and Catalyst Development: Conduct studies on molecular modeling for the hydrocracking of F-T wax to diesel. Devise technology for application of combinatorial	Molecular Modeling and Catalyst Development: Conclude all activity in an orderly manner with prior year funds. (\$0)

III. **Performance Summary:** FUELS (Cont'd)

<u>Activity</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>
	reduced CO ₂ byproduct. (\$810) (TBD)	chemistry techniques at high temperatures and pressures. (\$250) (SNL)	
	Study options for incorporation of fuel and chemical modules in Vision 21 plants. (\$50) (NETL)	Advanced Concepts: Investigate advanced concepts underlying the production of ultra-clean fuels and chemicals that would provide the scientific basis for new technology. (\$2,962) (TBD)	Advanced Concepts: Conclude all activity in an orderly manner with prior year funds. (\$0)

III. **Performance Summary:** FUELS (Cont'd)

<u>Activity</u>	<u>FY 2000</u>	<u>FY 2001</u>	<u>FY 2002</u>
Advanced Fuels Research (Cont'd)	Fund technical and program management support. (\$22)	Fund technical and program management support. (\$49)	No activity. (\$0)
	\$2,160	\$4,889	\$0
Steelmaking	Steelmaking: Conduct industry cost-shared demonstration of a revolutionary coke making process that produces metallurgical grade coke at lower cost and with virtually zero emissions. (\$6,457) (TBD)	Steelmaking: Conduct industry cost-shared demonstration of a revolutionary process that produces direct-reduced iron at lower cost and with virtually zero emissions. (\$6,618) (TBD)	No activity. (\$0)
	Fund technical and program management support. (\$67)	Fund technical and program management support. (\$67)	No activity. (\$0)
	\$6,524	\$6,685	\$0
Fuels, Total	\$19,844	\$23,423	\$7,000